CAIS STANDARD MANUAL

SYSTEM NO. 24
NATURAL GAS
DISTRIBUTION SYSTEM

CAS PROJECT
CAIS MANUAL

Issued April 28, 1995

8 Mar 96

MEMORANDUM FOR DTIC-OCP
ATTN: Ms. Lue Lynch
8725 John J. Kingman Road, Suite 0944
Fort Belvoir, VA 22060-6218

FROM: AL/EQ (STINFO)
139 Barnes Drive. Suite 2
Tyndall AFB FL 32403-5323

SUBJECT: Transmision of Technical Documents

1. As per telephone conversation with Andrew Poulis, EQ/TIC, the attached CAIS CTDS manuals are forwarded for accession, cataloging, and microconversions. Please forward the accession numbers to:

Andrew Poulis
AL/EQ/TIC
139 Barnes Drive. Suite 2
Tyndall AFB, FL 32403-5323

2. The Distribution statement should read as follows: Approved for Public Release: Distribution Unlimited.

3. If you have questions about these documents, please contact Andrew Poulis at DSN 523-6285.

Larry L. Testerman
LARRY L. TESTERMAN
Scientific and Technical
Information Program Manager

Atchs: Manuals

24 NATURAL GAS DISTRIBUTION SYSTEM

TABLE OF CONTENTS

24 NATURAL GAS DISTRIBUTION SYSTEM

APPENDICES

24 NATURAL GAS DISTRIBUTION SYSTEM

ABSTRACT

GENERAL ORGANIZATION

At this installation the list of facilities to be surveyed, including infrastructure, will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a related list of components. Detailed observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

INSPECTOR'S GUIDE

I. General
   - A. Level I Inspection Method Description
   - B. Level II Inspection Method Description
   - C. Level III Inspection Method Description

II. General Inspection
   - A. Process. This section describes the process of the inspection activity.
   - B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.

III. Inspector Qualifications
   This section notes the minimum qualifications for the person or persons performing the survey.

IV. Inspection Unit
   This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.

V. Unit Costs
   This section notes the nature of repair costs for this system.

VI. Standard Safety Requirements
   This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.

VII. Standard Tools
   This section lists a set of standard tools required for the general conduct of this survey.

VIII. Special Tools and Equipment Requirements
   This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

24 NATURAL GAS DISTRIBUTION SYSTEM

IX. Level II Inspection Method Keys
This section explains and locates Level II Key sheets.

X. Level III Inspection Method Keys
This section explains and locates Level III Key sheets.

XI. Replacement Cost
This section describes the nature and location of replacement cost data.

XII. Appendices
Appendix A. Provides a summary and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix C. This section contains a listing of the average life cycle durations for each assembly* in the Standard.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Natural Gas Distribution System.

INSPECTION METHODS

Description
Describes the nature of what is to be condition surveyed.

Special Tool and Equipment Requirements
Lists any special tools required for this specific subsystem.

Special Safety Requirements
This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

Component List
All components to be surveyed under this subsystem are listed here.

Related Subsystems
All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.

24 NATURAL GAS DISTRIBUTION SYSTEM

Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

References

This page lists the reference sources from which the foregoing subsystem data was developed.

Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

24 NATURAL GAS DISTRIBUTION SYSTEM

INSPECTOR'S GUIDE

I. GENERAL

A. Level I Inspection Method

The Level I Inspection Method of natural gas distribution systems consists of a thorough inspection of the above ground portions of the system. The survey activity is designed to be performed by a single surveyor. Although the natural gas system consists of underground, and above ground portions the underground portions cannot be surveyed during the Level I inspection.

B. Level II Inspection Method

Level II inspections are triggered by defect/observations noted at the Level I inspection or in some cases, are required to conduct a meaningful survey of the component being surveyed. There are only a few Level II inspections in Natural Gas Distribution Systems. They occur typically where access to the component being surveyed is required through a manhole or other structure. Level II inspections are referenced by defect/observations through a "Level II key", which denotes a specific Guide Sheet that describes the Level II inspection activity.

C. Level III Inspection Method

The Level III inspection is triggered by defect/observations occurring in the Level I and II inspections. The Level III inspection can also occur as a result of time based scheduling, antidotal experience, or component age compared to its life cycle. The Level III inspection is referenced through a Level III key which in turn, denotes a specific Guide Sheet describing the Level III inspection process and requirements. Level III inspections produce a detailed, written engineering assessment of the deficiency along with an estimated cost of correction, and are performed at the option of the Facility Manager.

II. GENERAL INSPECTION

A. Process

Surveys are normally conducted at the component level. Figure 24.-A provides the breakdown from system through component for the Natural Gas Distribution System. The surveyor will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the surveyor will be provided a list of defects, each of which is described further in detail as observations. These observations are described to various levels of severity as they relate to the effect of the life of the system. The quantification of each deficiency is identified by the surveyor using the associated unit of measure. Once an observation is populated with a deficient quantity, the inspector will be requested to provide information on the component type and location. The installation date or age of the component may be preloaded into the WBS for each asset from the Real Property Inventory List or site specific information.

24 NATURAL GAS DISTRIBUTION SYSTEM

In the case of Natural Gas distribution this will take the form of site related maps of the Natural Gas distribution System showing routing and size. If necessary age data can be overridden by the surveyor, Site CAIS personnel, or the Facility Manager.

B. Location

Level I and II inspections will be located by the surveyor through a discrete entry in the Field CAIS. The "IU", (Inspection Unit) will be derived from Facility supplied maps, and segment numbering lists, or other I.D. numbering systems. In all cases plans and maps shall be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no other means of location exist the inspector shall enter a brief (65 character) description of location. Locations must be accurate to insure future repeatability and consistent results.

III. INSPECTOR QUALIFICATIONS

The minimum Inspector qualification for the Natural Gas Distribution System requires a five year journeyman. Experience or familiarity in the areas of pipe, valve and gas meters is desirable but not required. All of the condition survey requirements for this system can be accomplished at the Level I inspection by a single inspector, however, safety and other considerations may require that inspectors work in teams. Inspectors will be specifically trained in the CAS system and its usage and will be CAS certified in the "Mechanical" discipline.

IV. INSPECTION UNIT (IU)

The Inspection Unit is normally defined at the component level for this system. If the unit of measure is each the IU is each. In the case of a unit of measure that is square feet, or linear feet the IU is determined by the identification of its location, such as sections of pipe, etc. IU's may include one occurrence of each component or multiple occurrence of a single component (e.g. multiple valves occur in piping section). Defect quantities are captured by the inspector for each occurrence with the discrete component, (defect quantities are tied to each pipe section as a unique component, but the component pipe may have only one discrete unit since it is a contiguous length.)

If the inspector finds multiple defects that occur in the same pipe length, the inspector will quantify the observation that is considered most severe and identify the remaining quantity under the less severe observation for the discrete component.

V. UNIT COSTS

The unit costs that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair cost.

24 NATURAL GAS DISTRIBUTION SYSTEM

VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the condition survey.

Inspector may utilize the following protective gear:

- Hard hat - to be worn during all surveys
- Safety glasses - to be worn during all surveys
- Safety shoes - to be worn during all surveys
- Coveralls - to be worn as necessary
- Gloves - to be worn as necessary
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling is required
- Rain suit - to be worn as necessary
- Wet suit - to be worn as necessary

VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all survey activities
Data Collection Device (DCD)
Battery pack for DCD
Flashlight
Tape measure - 30'
Rule - 6'
Tool bag
Screwdrivers -
    Phillips
    Straight slot
Knife

VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At the subsystem level, the deficiency standard has identified special tools and equipment required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular advanced method of inspection.

Facility Managers should review these sections in order to determine any special tool requirements for subsystems they are to inspect/survey.

IX. LEVEL II INSPECTION METHOD KEYS

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where a Level II inspection is flagged. The Level II key at the observation level will refer to a specific guide sheet.

All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

24 NATURAL GAS DISTRIBUTION SYSTEM

X. LEVEL III INSPECTION METHOD KEYS

Certain observations will trigger a Level III inspection. The Facility Manager will be able to identify deficiencies where a Level III inspection is flagged. The Level III Key at the observation level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

XI. REPLACEMENT COST

A replacement cost for each subsystem type will be contained within the cost estimating system in the Site CAIS.

XII. APPENDICES

Appendix A - Abbreviations

A summary and definition of all abbreviations used in this system are contained in Appendix A which is located at the end of Natural Gas.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Natural Gas.

Appendix C - Life Cycles

A listing of the average life cycle durations for each assembly* in the Standard.

Note - Facility Manager's Guide

The following are included in the Facility Manager's Guide:

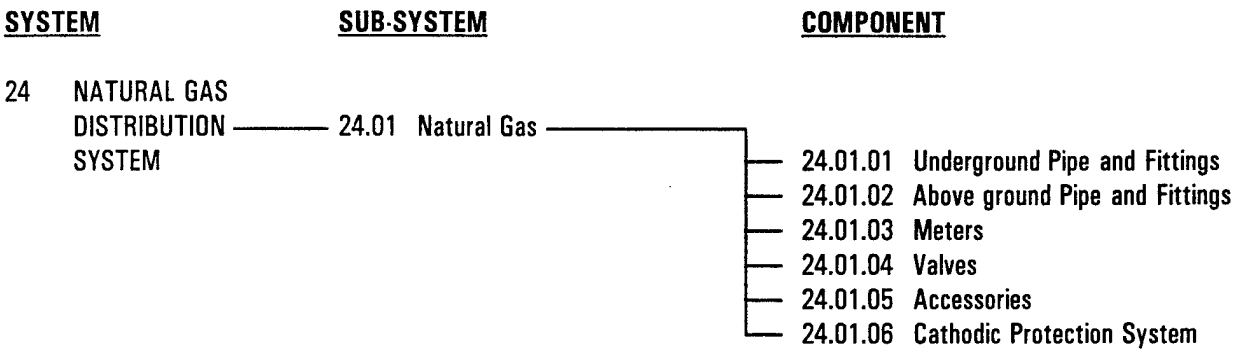
A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspection for time driven Level III's.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

24 NATURAL GAS DISTRIBUTION SYSTEM

Figure 24-A. WORK BREAKDOWN STRUCTURE



24.01 NATURAL GAS

DESCRIPTION

Natural gas is distributed through a system of underground piping from the point at which the Gas Transmission Company's, (supplier), high pressure pipe line connects to the facility distribution system. There may be more than one connecting point, however, that is rare and occurs only on large facilities if at all. Transmission line pressures are higher than distribution lines on the facility thus it is expected to find a Pressure Reducing Valve at the supplier connection to reduce to distribution pressures. On some bases, the received pressure is used for distribution. The distribution piping supplies a range of 10 to approximately 50 psi gas to the using facilities and buildings through a local facility meter, and a further pressure reduction valve that reduces gas pressure to a maximum of 5 psi, but more often to 2 psi or less. In most cases these devices occur above ground and directly adjacent to the using building. The further distribution of natural gas inside the building is covered in other sections.(see related Systems, Subsystems and components). In this subsystem the Inspection Unit "IU" is at the component level.

SPECIAL TOOLS AND EQUIPMENT

The following list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are required to perform the inspection of the Natural Gas system:

1. Leak Detection Fluid
2. 1" paint brush, new, soft bristle
3. N. G. "Sniffer", Combustible Gas Indicator (2 scale type)
4. Digital Multimeter w/batteries (Fluke model 77 DMM preferred)
5. Dielectric Checker (Model 601, Gas Electronics Co., Seymor, MO.)
6. Pit Depth Gage (McMaster Carr, 10" depth dial gage)

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of the Natural Gas subsystem beyond the requirements listed in the Master Safety Plan and the Natural Gas Distribution System Safety system section. Inspectors should be mindful of the medium, (natural gas), being inspected which is flammable and under the correct conditions explosive. Inspectors should refer to OSHA 1910.119 Process Safety Management of Highly Hazardous Gases for additional guidance.

COMPONENT LIST

- 24.01.01 UNDERGROUND PIPE AND FITTINGS
- 24.01.02 ABOVE GROUND PIPE AND FITTINGS
- 24.01.03 METERS
- 24.01.04 VALVES
- 24.01.05 ACCESSORIES
- 24.01.06 CATHODIC PROTECTION SYSTEM

24.01 NATURAL GAS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

08.00	BUILDING MECHANICAL (all subsystems)
28.00	SITE CENTRAL HEATING PLANT (all subsystems)

STANDARD INSPECTION PROCEDURE

The Natural Gas Subsystem requires both Level I and II inspections as part of the basic inspection process. Additional Level II and III inspections may be indicated or "Triggered" by Level I inspection defect/observations.

COMPONENTS

◆ 24.01.01 UNDERGROUND PIPE AND FITTINGS

Underground gas pipe consists of metallic pipe with a protective wrapping or coating and plastic pipe. This buried pipe is susceptible to corrosion caused by electrolysis between soils of such a chemical composition that produce minute currents of electrical energy flowing between the soil surrounding the pipe and the metal of the pipe thereby decomposing the metallic structure (wall) of the pipe. The presence of moisture accelerates this process. Plastic pipe is inert to this type of action and corrosion. Level I inspection of this component See the Level III Guide Sheet, GS III 24.01.01-1 for a Level III program of inspection.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Underground Pipe Deterioration:**			
Observation:			
a. Corroded and deteriorated pipe and fittings.	LF		1*
*** {Severity H}			
b. Observed indication of gas leakage.	EA		1*
*** {Severity H}			

24.01 NATURAL GAS

COMPONENTS (Continued)

◆ 24.01.02 ABOVE GROUND PIPE AND FITTINGS

Above ground Natural Gas pipe and fittings consist of metal pipe, usually steel, with thread and couple malleable fittings or welded steel pipe with weld or flanged fittings. All thread and couple joints are made with pipe dope or tape to assist in the gas tight seal of the joint and in the case of flanged fittings, a gasket material compatible with natural gas is used.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Pipe Corrosion:**			
Observation:			
a. Mild corrosion, discoloration no pitting.	LF		
*** {Severity L}			
b. Evident corrosion, pitting, and scaling.	LF		
*** {Severity M}			
c. Obvious corrosion, deep pitting over 1/8 Inch deep, heavy staining.	LF		
*** {Severity H}			
d. Severe Corrosion, deep pitting CP system failure indicated.	LF		3
*** {Severity H}			
Defect:			
*** Physical Damage:**			
Observation:			
a. Dents, chips and nicks in pipe no leaks.	EA		
*** {Severity L}			
b. Pipe support loose damaged or missing.	EA		
*** {Severity L}			
c. Bent, crimped or deep dents in pipe.	EA		
*** {Severity M}			
d. Pipe under compression stress at fitting or valve, minor leakage	EA		
*** {Severity H}			
e. Pipe split, deformed, misaligned, with obvious gas leakage.	EA		
*** {Severity H}			
f. Strainers show physical damage or deterioration.	EA		
*** {Severity H}			
g. Valve box or cover damaged.	EA		
*** {Severity M}			

24.01 NATURAL GAS

COMPONENTS (Continued)

◆ 24.01.03 METERS

Meters are an inline device that measures the volume of Natural Gas used at a specific facility being served. The measurement is in normally in cubic feet, indicated on multiple circular meter/indicators. Small meters, basically residential type, are mounted on the incoming gas service piping. Meters serving large facilities are mounted on a concrete pad.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Meter Defective:**			
Observation:			
a. Meter has painted over indicating dial.	EA		
*** {Severity L}			
b. Meter is damaged, proper operation is questionable. (See facility personnel).	EA		
*** {Severity M}			
c. Gas pipe connection to meter is loose, damaged, or misaligned, with gas leaking	EA		
*** {Severity H}			
Defect:			
*** Meter Corrosion:**			
Observation:			
a. Light rust and corrosion, meter operational.	EA		
*** {Severity L}			
b. Obvious metal corrosion, with pitting, scaling, meter operational.	EA		
*** {Severity M}			
c. Serious corrosion, loss of metal, holes meter operation questionable.	EA		
*** {Severity H}			

24.01 NATURAL GAS

COMPONENTS (Continued)

◆ **24.01.03 METERS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Concrete Meter Pad Defective:**			
Observation:			
a. Concrete pad has cracks greater than 1/16 inch and less than 1/8 inch.	LF		
***{Severity L}			
b. Concrete has spalling along edges and cracks.	SF		
***{Severity M}			
c. Cracks larger than 1/8 inch, with efflorescence, and exposed reinforcing steel.	SF		2
***{Severity H}			

24.01 NATURAL GAS

COMPONENTS (Continued)

◆ 24.01.04 VALVES

Natural Gas Valves include shutoff valves, of the globe, gate, square head cock, or wedge cock types, and pressure reducing valves that transform a high incoming pressure from the distribution main to the lower pressures used within facilities. Pressure reducing and control valves are vented to outside atmosphere. Dielectric isolation fittings occur most usually at valve locations in the gas piping system and must meet isolation criteria found in NACE RP-02-86.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical Wear and Damage:**			
Observations:			
a. Leaking at pipe connections. *** {Severity H}	EA		
b. Leaking in body of valve or actuator stem. *** {Severity H}	EA		
c. Bent valve stem. *** {Severity H}	EA		
d. Actuator, (manual or automatic) inoperative. *** {Severity H}	EA		
e. Missing dielectric isolation joint. *** {Severity H}	EA		4
f. Inoperative isolation joint. *** {Severity H}	EA		4
Defect:			
*** Inoperable Pressure Reducing Valve:**			
Observation:			
a. Diaphragm relief port clogged. *** {Severity H}	EA		
b. Reducing valve relieving gas to atmosphere. *** {Severity H}	EA		
c. Pressure reducing/control valve not connected to outside atmosphere vent *** {Severity H}	EA		

24.01 NATURAL GAS

COMPONENTS (Continued)

◆ 24.01.05 ACCESSORIES

The Underground gas piping system has limited access through the medium of manholes. Inspectors should consult the Master Safety Plan for the requirements involved with the entry into confined spaces. This may involve more than a single inspector to meet those requirements.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Manhole Deterioration:**			
Observations:			
a. Manhole cover rusted, corroded, does not fit accurately, allows water into manhole.	EA		
*** {Severity L}			
b. Manhole frame rusted, corroded.	EA		
*** {Severity L}			
c. Steel step rungs, rusted, corroded, steps still usable.	EA	1	
*** {Severity L}			
d. Concrete walls and floor cracked with cracks less than 1/8 inch width, minor spalling and seepage	EA	1	
*** {Severity L}			
e. Steel rungs damaged to the point of not being serviceable.	EA	1	
*** {Severity H}			
f. Concrete walls and floor with cracks more than 1/8 inch width, spalling, efflorescence, and evident leaks and seepage.	EA	1	
*** {Severity H}			

24.01 NATURAL GAS

COMPONENTS (Continued)

◆ 24.01.06 CATHODIC PROTECTION SYSTEM

There are two types of cathodic protection systems, the galvanic anode system and the impressed current system. Either system can be used for protecting any one item from chemically-based, electrically-induced metal corrosion.

Natural gas related items requiring cathodic protection are underground metal tanks and underground metal gas piping.

Evaluation and Monitoring of cathodic protection systems requires a Level III inspection. The U.S. Department of Transportation thru 496FR, Part 192 requires monitoring of cathodic protection systems for underground gas pipelines at specified intervals. Other cathodic protection systems should be monitored in a manner similar to those with specific government requirements. All agencies require dated records of inspection, performance, findings and any corrections made.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Monitoring Records:**			
Observation:			
a. CP records missing or not complete. *** {Severity H}	Set		3
b. CP test schedule not followed per requirements. *** {Severity H}	Set		3
c. CP system not installed. *** {Severity H}	EA		3
d. CP system is inoperative. *** {Severity H}	EA		3

24.01 NATURAL GAS

REFERENCES

1. "GPIPER", Gas Pipe Assessment Program authored by CERL, Champaign, IL
2. Airco Gas Products and Systems catalog
3. TRADOC, "SUPER", Strategic Utility Planning Evaluation Routine, Chguernsey and Co., April 1992
4. NFPA 54, National Fuel Gas Code
5. BOCA, National Mechanical Building Code, Article 8 Sections M-800 through M814 (Chapter 4101:2-39)
6. ASHRAE, "Fundamentals Volume", 1989, Chapter 15, page 15.4
7. ACI Manual of Concrete Inspection, Detroit, MI. American Concrete Institute
8. Draft TM - 5 - 654 Gas Distribution System Maintenance and Operation
9. NACE, (National Association of Corrosion Engineers) Standards, RP0 169-92, RP0 286-92, RP0 388
10. ETL 1110-3-440, (Engineer Technical Letter) DPO 20 August 1992
11. ETL 110-9-10 (FR), CP with Ceramic Anodes

24.01 NATURAL GAS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS II 24.01.05-1

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1*	GS III 24.01.01-1*
2	GS III 24.01.03-2
3	GS III 24.01.06-3
4	GS III 24.01.04-4

* Indicates Guide Sheets which are not directly referenced by a "Key". These are "triggered" by information in addition to this inspection process such as time cycle, age compared to life cycle or repeated service or maintenance calls.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: ACCESSORIES/MANHOLES
CONTROL NUMBER: GS-II 24.01.05-1

Application

This guide sheet applies to the conduct of inspections made inside manhole structures.

Special Safety Requirements

Special Safety Requirements include the OSHA requirements for entry into confined spaces, as well as compliance with the Master Safety Plan and the requirements of the System section of the Inspector's Guide as it relates to safety issues. The inspection should be conducted with two inspectors and the use of a harness and recovery rope attached to the inspector entering the manhole.

Inspection Actions

1. Prior to entering the manhole, the inspector should test the step rungs before committing full weight to them

2. The inspector will inspect the remainder of the manhole structure and its accessories as outlined in the defect/observation list.

Special Tools and Equipment

No special tools or equipment are required beyond those listed in the Standard Tools section of the System's Inspector's Guide.

Recommended Inspection Frequency

This Level II inspection is performed at the time of each Level I inspection, or when directed by the Facility Manager.

References

1. ACI Manual of Concrete Practice, Part I, Materials and General Properties of Concrete, 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1*

COMPONENT: UNDERGROUND GAS DISTRIBUTION PIPING
CONTROL NUMBER: GS-III 24.01.01-1*

Application

This guide has been prepared to identify the Level III inspection procedure with its more sophisticated test and inspection methods to determine the cause and/or extent of defects in underground gas distribution piping. It is conducted on a timed interval basis only.

The Level III inspection should be performed by personnel trained in the use and application of the inspection method recommended.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and in the Standard Safety Requirements of the System Inspector's Guide.

Inspection Actions

1. The Facility Manager should implement fully the "MicroGPIPER" program as prepared by and available from CERL, The U.S. Army Corps of Engineer Construction Engineering Research Laboratory, in Champaign, Illinois. This system provides a PC computer-based program to track and project deterioration in underground gas distribution piping, based on local soil condition, type of piping and method of installation. Adoption of this program will provide the Facility Manager with a comprehensive overview of the condition of this Natural Gas distribution Piping System. The Facility Manager will in all cases be the controller of any and all excavation performed as part of the implementation of this program.

2. If Level I Inspection indicates the possibility of a leak, implement provisions of microGPIPER to "grade" prioritize leaks for repair.

3. Provide report of conditions to Facility Manager along with projected cost to correct deficiency.

Special Tools and Equipment

"MicroGPIPER" specified tools, instruments and equipment will be required above and beyond the requirements of the Standard Tools Section of the System Inspector's Guide.

Recommended Inspection Frequency

Per the requirements and instructions of the "MicroGPIPER" program.

References

1. "Micro-GPIPER", Gas Pipe Assessment Program, CERL, Champaign, IL.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: CONCRETE METER PADS
CONTROL NUMBER: GS-III 24.01.03-2

Application

This guide has been prepared to identify the purpose of a Level III inspection and its more sophisticated test and inspection methods which may be appropriate to determine the cause and/or extent of defects recorded in Level I or Level II defect observations of a concrete meter pad.

Whereas, the purpose of the Level I inspection was to record the observable defects at a meter pad, this Level III inspection is performed to provide a thorough, systematic evaluation of the observed defect and to make an assessment of its effects, if left unchecked, on the safety, durability and stability of the meter pad.

The Level III inspection should be performed when prompted by the results of a Level I or II inspection. The inspection should be performed by an engineer experienced in the design and construction of concrete slabs and equipment pads.

The results of the Level III inspection will be used to develop a remedial measure work strategy that will correct the existing deficiency conditions.

In general, appropriate advanced inspection methods will be identified, recommended, and performed by or under the supervision of the inspection engineer personnel as part of the Level III test and inspection method. Advanced inspection methods will be assigned only after the assessment of defect conditions observed during a Level I or II inspection.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and in the Standard Safety Requirements of the System Inspector's Guide.

Inspection Actions

1. Perform inspection of the component where observed defects triggered a Level III inspection.
2. Make an assessment of the importance of individual defects observed for a given component at the site. Indicate priorities for any required maintenance or remedial measure work.
3. Identify whether particular observed defects need continued observation.
4. Prepare final cost estimate for advanced inspection methods required to determine the cause and extent of the observed defect.
5. Prepare cost estimate for required maintenance or remedial repair measures, as applicable.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: CONCRETE METER PADS
CONTROL NUMBER: GS-III 24.01.03-2

Level III advanced inspection methods may be required for Level I and Level II defect conditions observed. Level III advanced test or inspection methods for observed defects for concrete meter pads include, but are not limited to the following:

	Advanced Test or Inspection Method	Applicable Observed Defects
1.	Concrete coring	Concrete deterioration, cracking and spalling
2.	Laboratory tests on concrete (core, strength tests, abrasion, absorption, sulfate soundness, unit weight)	Concrete deterioration
3.	Ultrasonic test	Cracks and voids in concrete
4.	Magnetic or half-cell test	Corrosion to reinforcement steel
5.	Soil borings	Ground instability and settlement

Special Tools and Equipment

Listed below are special tools and equipment required to perform this Level III inspection beyond those listed in the Standard Tools section of the Inspector's Guide:

1. Industry required testing equipment needed to perform the advanced investigation method chosen.

Recommended Inspection Frequency

Meter pads as triggered by Level I and II defect/observations.

References

1. ACI Manual of Concrete Practice, Part I, Materials and General Properties of Concrete, 1989.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: CATHODIC PROTECTION SYSTEM
CONTROL NUMBER: GS-III 24.01.06-3

Application

This guide applies to the investigation of cathodic protection systems and their functioning as it relates to buried underground natural gas piping. Note that the Corps of Engineers criteria set forth in ETL 1110-3-440, "CATHODIC PROTECTION" requires cathodic protection on all underground natural gas piping systems.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and contained in the Standard Safety Requirements section of the System Inspector's Guide.

Inspection Actions

1. Check for the presence of a cathodic protection system on the subject natural gas piping. This can be done utilizing a measure of the structure-to-soil potential with subsequent evaluation against the criteria found in NACE RP0169-92.

2. If a CP system is installed, review the inspection records to verify the findings of the Level I inspection.

3. Check for the proper performance of the CP system per the requirements of NACE RP0169-92.

4. Review the results of the inspection with the Facility Manager along with any further investigation recommended and the corrective actions indicated to be necessary.

5. Provide the Facility Manager with a complete report of findings, corrective measures and a projected cost for the actions necessary to repair the pipe, or bring the installation into compliance with the referenced standards.

6. Note nothing in the above procedure relieves the Facility Manager of his responsibility to perform periodic testing as required by law, code or other legal entities. Specifically this inspection will not substitute for, or be construed as meeting, those legal requirements.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: CATHODIC PROTECTION SYSTEM
CONTROL NUMBER: GS-III 24.01.06-3

Special Tools and Equipment

Listed below are special tools and equipment, beyond those listed in the Standard Tools Section of the Introduction and System Inspector's Guide, that are required to perform this Level III inspection:

1. Copper sulfate cell with test leads

Recommended Inspection Frequency

Do this Level III inspection when triggered by a Level I inspection.

References

1. NAVFAC MO-306.1, Maintenance and Operation of Cathodic Protection Systems, October 1992

2. Code of Federal Regulations, Title 40; Part 280, Part 192, Part 195

3. U. S. Army Regulation, AR 200-1

4. National Association of Corrosion Engineers (NACE) Standards:
   RPO169-92 - Control of External Corrosion on Underground or Submerged Metallic Piping Systems
   RPO286-86 - The Electrical Isolation of Cathodically Protected Pipelines

5. Materials Performance Magazine, September 1992; Computerized Monitoring of Cathodic Protection Systems for Underground Structures, by Vicki Van Blaricum and Ashok Kumar

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: DIELECTRIC ISOLATION FITTINGS AT VALVES
CONTROL NUMBER: GS-III 24.01.04-4

Application

This guide applies to the investigation of dielectric properties of fittings and other devices designed to prevent electrical current circulation in Natural Gas Piping systems and their components.

Special Safety Requirements

No special safety requirements are needed for the performance of this Level III inspection beyond those listed in the Master Safety Plan and contained in the Standard Safety Requirements section of the System Inspector's Guide.

Inspection Actions

1. Confirm the results of the Level I inspection. If no isolation exists and is required prepare a report for the Facility Manager recommending the type, model size and location for the required isolation device along with an estimate of the cost for providing same on an installed basis.

2. Where a dielectric fitting is installed but corrosion is also present as indicated by the Level I inspection, a check of the operational status of the fitting is necessary. Using the insulation checker listed in the Sub-System list of special tools, a determination is made regarding the effectiveness of the isolation device. If the readings taken indicate a current path through the isolation device it will require replacement.

3. The level III inspector should report to the Facility Manager concerning the location and condition of these dielectric problems and should recommend corrective actions along with an estimate of their and any other attendant costs required to correct the deficiency noted.

Special Tools and Equipment

No special tools are needed for the performance of this Level III inspection beyond the requirements listed in the Standard Tool Section of this System and it's Sub-System.

Recommended Inspection Frequency

Do this Level III inspection when triggered by a Level I inspection.

References

1. NACE standard, RPO169-92.

APPENDIX A

ABBREVIATIONS

ANSI	American National Standards Institute
Approx.	Approximately
ASHRAE	American Society of Heating, Refrigeration & Air-Conditioning Engineers
CAIS	Condition Assessment Information Survey
CAS	Condition Assessment Survey
CHLOR	Chloride
CL	Class
CP	Cathodic Protection
DIA	Diameter
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EA	Each
EXT	Exterior
Fig	Figure
GPM	Gallons per minute
HNGR	Hanger
HVAC	Heating, Ventilating, and Air-Conditioning
HW	Hot Water
IN	Inch
INCL	Including
INT	Interior
IU	Inspection Unit
LF	Linear Feet

APPENDIX A

NFPA	National Fire Protection Association
OA	Outside Air
PRV	Pressure Regulating Valve
PSI	Pound-force per square inch
PVC	Polyvinyl Chloride
SDR	Standard Dimension Ratio
SF	Square Foot
UOM	Unit of Measure
USACERL	U.S. Army Corps of Engineers, Construction Engineering Research Lab
WBS	Work Breakdown Structure
W/	With
"	Inch or inches
'	Foot or Feet
>	Greater than
<	Less than

APPENDIX B

GLOSSARY

Check Cracks	Shrinkage cracks in concrete still bonded to its base
Control Valve	A valve that permits regulation of gas flow in a piece of equipment, or feeder.
Efflorescence	Mortars or cements that contain excess soluble salts will contribute to masonry efflorescence. Efflorescence can only occur when water penetrates the masonry or concrete, dissolves the salts, and upon evaporation, deposits them on the face of the wall. The surest efflorescence preventative is to keep water out of masonry or concrete.
Foam Leak Detector	A system of soap bubbles or special foaming liquids brushed over joints and connections to locate leaks.
Galvanic Action (Electrolysis)	Corrosion action between two metals or soils and metals of different electronic activity. The action is increased in the presence of moisture.
Gas Distribution Piping	A pipe in the infrastructure that conveys gas from the point of delivery to the points of building metering.
Gas Pressure Regulator	A device for controlling and maintaining a predetermined gas pressure.
Gas Service Piping	The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system of the building served.
Gas Valve	Device for controlling gas flow
Gate Valve	A valve designed so that the opening for flow (when the valve is fully open) is essentially the same as the pipe and the direction of flow through the valve is in a straight line.
Methane	A hydrocarbon gas with the formula CH_4 the principal component of natural gases.
Natural Gas	Any gas found in earth as opposed to gases that are manufactured.
Odorant	A substance added to an otherwise odorless, colorless, and tasteless gas to give warning of gas leakage and to aid in leak detection.

APPENDIX B

Manhole	An opening by which a man may enter or leave an underground conduit, or other closed structure for inspection, cleaning and other maintenance operations, closed by a removable cover.
Manhole Cover	A removable lid that closes the opening to a manhole or similar subsurface enclosure
Pressure Reducing Valve	A diaphragm-operated valve installed in a gas supply that reduces incoming pressure into the building gas distribution so as to prevent the system from possible exposure to pressures higher than the working pressure of the building system (5 psi max)
Pressure Regulator	A device for controlling and maintaining a uniform gas outlet pressure
Pressure Relief Valve	A device for protecting a section of the gas distribution system from excessive pressure by opening at a pre-determined pressure and discharging natural gas to outside atmosphere at a rate sufficient to prevent further build-up of pressure.
Repair	Restoration of a facility or equipment to a condition that allows it to be used for its intended purpose.
Scaling	The flaking or peeling away of the near-surface portion of hardened concrete or mortar.
SNG	Supplementary Natural Gas. Gases that are manufactured to duplicate natural gas.
Spall	A fragment, usually in the shape of a flake, detached from a larger mass by a blow, weathering, pressure or expansion within the larger mass.

APPENDIX C

LIFE CYCLE

24 NATURAL GAS DISTRIBUTION SYSTEM

24.01 NATURAL GAS

Natural Gas Distribution System	40 YRS

Source:
USACERL, Technical Report FM-93/07, January 1993